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Memory Management - An Efficient Key Value Storage with the usage of Dynamic Random Access Memory

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Abstract — Efficient key value storage has become one of the significant and most sought out need for the current storage aspects. The efficiency of key value basically depends on the Atomicity, Consistency, Isolation, and Durability (ACID) properties. The key value holds necessary commands to handle the data. Those key values must have a systematic basic storage and it can be either fixed size or varied length. This systematic storage should be augmented, consecutive, distributed, sustainable and stable. Distributed key value storage helps us to maintain necessary scalability and availability of data. In this paper, the storage discrepancies can be resolved with the mass storage scheme such as Dynamic Random Access Memory (DRAM).

Keywords — *Key-Value; Memory; Random Access Memory Cloud;* Dynamic Random Access Memory; *Latency; Capacitors.*

1. Introduction

A single node can store up to several billions of key values based on flash storage. To achieve low latency, high performance and to make the best use of Input/Output resources, the key value storage system uses factor indexes memory. The key value storage has been receiving a drastic attention among commercial and academic domain. In case of virtual indexes, key value is often encoded in such a way that, end part of the key is always defined using any smaller byte value where as corresponding key efficient indexes are to locate data. Since, key value scales both size and performance and inter-related value uses byte-wise comparison. Key value storage has been the critical part or crucial block on many social networks. Modem ISDN Channel Aggregation (MICA) provides either store semantics or cache semantics [1]. Dynamic allocators has been one of the common way to store the key value because, they provide only limited queries and single key transactions where, the queries can also be given with advanced features. Key value storage requires low-overhead network communication between clients and servers.

Achieving this key value storage efficiency make us to have a rethinking on network stack and key-value data structures [2]. The disadvantage of using dynamic allocators is that they provide only limited usage of queries and single key transaction which lacks a lot. Hence, it could be worked to improve efficient multiple transactions. But the complex elimination of items can affect the key value storage throughput. It is also important to avoid problems such as network stack, system calls and cached data layout which would yield to significant performance for in-memory storage. DRAM manufacturers have created several new DRAM architectures. DRAMs are designed for the sole purpose of storing data. The basic and valid operation on memory device is to write the data on the device or to read the data from the device and also refreshing it in a while. To improve the speed of such functions many methods have been identified. Thus DRAM has been implanted on the RAM cloud to perform such operations on memory in an efficient way. DRAM is a capacitor that is usually charged to produce either 1 or 0. There have been many structures evolving over time to create memory cells but, in this paper, we use dielectric material to create capacitive storage area of a memory cell.

2. Existing System

The existing system such as MICA does not ensure durability, concurrency, and data in main-memory. The main disadvantage is that it is not a distributed, center which is needed for modern networks. Hence, the lack in these features may not attract the users to prefer such data storage systems.

2.1.Disadvantages of Street Light System

- One cannot achieve the necessary efficiency and speed in the key value storage.
- The silt node performance is limited by sorting.
- It uses many flash drives.
- More Central Processing Unit (CPU) cores are needed.

3. Proposed System

With the application of RAM cloud, one can overcome the disadvantage of the features that lack in MICA and other systems. Since RAM cloud ensures scalability durability and is highly consistent. Key value is a critical or crucial part of databases on many social networks. Hence, they must be protected and should overcome their lags with the implementation of clusters or RAM cloud in the in-memory management.

3.1 Advantages of Proposed Street Light

- Constant usage of in-memory helps us to overcome the large requirements of flash storage.
- The data has to be maintained in the in-memory for easy retrieval.
- Usage of DRAM can achieve consistency, durability, and concurrency.

4. Methodology

Mainly the key space should be:

- Sharable.
- Name spaced.
- Efficient.
- As collision-less as possible.

Hence, for the mass storage space for storing the key value has the better choice of implementing RAM cloud. RAM cloud has a special component known as DRAM which stores each bit of data in a separate capacitor. RAM cloud always stores the data in DRAM but also ensures the durability by storing its data in secondary storage for further retrieval. Since, it stores data in secondary memory, it does not support online data storing. But always provides it's availability by making recoveries from crashes. RAM Cloud aggregates all memories into a single coherent key-value store. This allows storage capacities of 1PetaByte or more [3].

RAM Cloud uses a unified log-structured approach for managing data both in memory and on secondary storage. This allows backup copies to be made efficiently so that RAM Cloud can provide the durability of replicated disk and the low latency of DRAM. The RAM cloud also faces some crashing of data but within sometimes the crash recovery can be recovered by efficiently using twice the capacity of DRAM. By using two levels for cleaning the log structures; DRAM gains the space and also it minimizes the I/O bandwidth [4]. The number of errors must be minimized to reduce the complexity of fault tolerance. The design should also support the network speed and memory capacity. RAM cloud using DRAM should focus on low latency and a major storage space, i.e. 5μs for small clusters and 10μs in a large datacenters [5]. This represents an improvement of 50 to 1,000 times over typical storage systems used by Web applications today. The source code of RAM is easily available and the cost of implementation of RAM cloud varies on the size of the RAM cloud server for its implementation. The cost factor is not highly considered by the entrepreneurs since data storage has become most mandatory and vital for business.

5. Implementation

The core purpose of key value in the main memory or in-memory is for the easy access and easier retrieval of key value from the main memory. To increase the storage of key value in main-memory planting RAM cloud in the main-memory can be implemented. The RAM cloud is constructed using Dynamic Random Access Memory. DRAM contains insulated capacitors. The capacitors are charged or discharged based on 0 or 1bit. The largest application of DRAM is the usage of main-memory. These DRAM's are injected in the RAM cloud for enormous storage facility.

Fig.1: DRAM-chip

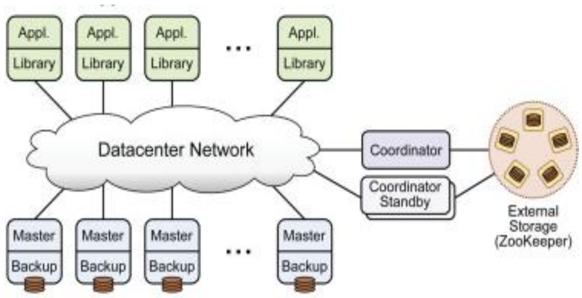

Fig.2: Storage in RAM cloud

Thus the structure of RAM cloud has the master and the backup servers with an external storage and application libraries.

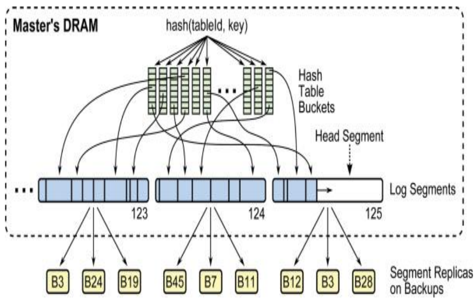

Fig.3: Working of DRAM

DRAM has been emerging as one of the sought out storage medium for large key value storage. Hence the following graph has been constructed to show the tremendous growth in the usage of DRAM.

6. Result

Based on the figure 4, it is clearly known that usage of DRAM has been high in the graph over years.

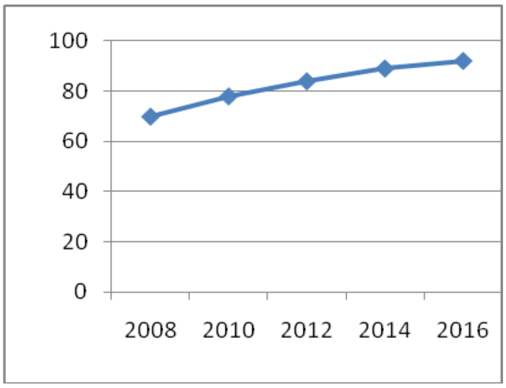

Fig.4: Usage of DRAM over years

6. Conclusion

By implementing RAM cloud, the storage issues on key value can be satisfied up to the adequate level. The RAM cloud thus, makes the usage of Dynamic RAM. Replication is not much easy in DRAM though it can be done faster. DRAM stores each bit of data in separate capacitor, thus requires high energy.

Apart from the power issues, DRAM is very high in cost to implement. Moreover it requires immense space to get arranged to a region. DRAM has low access rate. But it includes operations such as reading, writing and refreshing data on the capacitors. The refreshing rate is also high at 1000time/sec.

7. Future Enhancement

By analyzing all these features the type of database storage must be finalized. The RAM cloud satisfies almost 94% of these conditions. In other cases, the key values can be stored in HYPERDEX which is also an in-memory storage area. In some cases, the RAM cloud can be replaced by HYPERDEX as it contains rich Application Program Interfaces (API's). HYPERDEX is also fault tolerant. It also provides an efficient breakthrough for the users.

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